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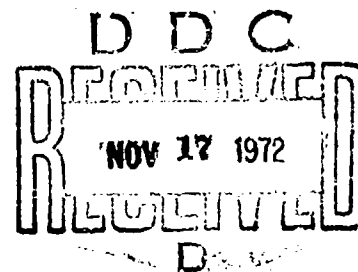
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FIELD DEPENDENCY - INDEPENDENCY

A Review of the Literature

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PURPOSE OF PAPER

The concept of field dependency-independency originated by H. Witkin over 20 years ago has become increasingly popular in recent years. As a theoretical construct it has served to initiate and direct research concerned with its own validity and scope and perhaps more importantly has also served to unify reported findings from many diverse realms. Perceptual, clinical, and personality theorists and researchers have all employed the field dependency-independency concept. In recent years the Rod-and-Frame Test (RFT) and the Embedded Figures Test (EFT), both theoretical indices of an individual's field dependency or independency, have been used as effective tools in the investigation of very practical, "real-world" phenomena and problems. For example, Barrett and Thornton (1968) reported a significant relationship between performance on the RFT and driver reaction in an emergency automobile situation. On the basis of this finding, they proposed the possible use of the RFT in screening applicants for jobs involving extensive driving. Kennedy (1972) reported EFT scores to be significantly related to success in aviation training for both naval aviators and naval flight officers. He, therefore, suggested the EFT be included in the existing battery of selection tests for aviation applicants.

With this increasing popularity of the concept in general and the possible practical value of its measures in real-world application, the Naval Aerospace Medical Research Laboratory has expressed interest in the field dependency-independency concept, especially with regard to its possible utility in pilot selection. The present paper was, therefore, undertaken as an extensive review of the perceptual style. It is hoped that this monograph presents an objective picture of the "state of the art" of Witkin's perceptual dimension.

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May 1972

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The descriptive concept of "perceptual style" has been a rather popular approach to the recurrent problem in perception of the consistent and significant individual differences exhibited by individuals on any number of perceptual tasks. On the one hand, such an approach has allowed the theorist and researcher to treat the grossly apparent variability of human perceptual behavior in a somewhat logical and unified manner. On the other hand, however, it has resulted in the introduction into psychology of new terms or constructs of often questionable utilitarian and even less explanatory value. Even a rather cursory review of the perceptual literature yields a number of proposed "styles" or modes of perceptual functioning which operationally serve to differentiate individuals by the manner in which some particular stimulus event is perceived. As examples of some of these styles, Bartlett (1932) proposed the distinction between "confident" vs "cautious" perceivers, Holzman and Klein (1950, 1954) between "levelers" vs "sharpeners," Altrocci (1961) between "repressors" vs "sensitizers," Zegers and Murray (1962) between "high perceivers" vs "low perceivers," Petrie et al., (1963), and Silverman et al., (1969) between "augmenters" vs "reducers," and Elithorn and Barnett (1967) and Kennedy (1970) between "narrow" vs "broad" band-pass individuals. The most popular of the perceptual styles within the last 20 years, however, has unquestionably been that of "field-dependent" vs "field-independent" individuals, originated and largely developed by Witkin and his co-workers (1948a, 1948b, 1949a, 1949b, 1950, 1954, 1959, 1962, 1965, 1967, 1968).

The present paper represents an empirical and theoretical review of the literature on Witkin's proposed concept of field dependency-independency, in an

attempt to determine the value of the concept both as a unifying construct in the perceptual realm and as a practical tool in applied research areas.

I. PSYCHOMETRIC REVIEW

Operationally, the perceptual style of "field dependency-independency" advanced by Witkin refers to the continuum of individual differences, ranging from extreme field-independency to extreme field-dependency, demonstrated on certain perceptual tasks, most commonly, the Rod-and-Frame Test (RFT) and the Embedded Figures Test (EFT). In its basic form, the RFT requires the individual to directly or indirectly adjust a movable rod to the true vertical position while the rod itself is located in a separately tilted frame. Individuals have been found to differ widely but reliably in their ability to ignore the distracting context of the "crooked" frame and set the rod to a truly vertical position (Witkin and Asch, 1948a, 1948b; Witkin, 1949a, 1949b; Witkin et al., 1954, 1962; Schuck et al., 1970; Cross et al., 1972). Concerning specific coefficients of reliability with the RFT, odd-even reliabilities of .92 and .89 have been reported by Gardner, Jackson, and Messick (1960) and Loeff (1961), respectively. Bauman (1951) found test-retest reliability on the RFT of .84 for men and .86 for women over a 3-year period. Furthermore, the invariance of the individual's RFT performance under various experimentally manipulated conditions of changing sets, instructions, familiarity with apparatus, and practice has been reported by a number of researchers (Elliott and McMichael, 1963; Olson et al., 1965; Witkin, 1967; Wade, 1970).

The other most commonly employed measure of field dependency-independency, the EFT, is a paper-and-pencil test which gives a measure of an individual's ability to detect rather simple geometrical figures contained within much more complex figures. On this test, also, rather large and consistent individual differences have been found (Witkin, 1950; Witkin et al., 1954). Reported odd-even reliability coefficients for the EFT in the literature include: $r = .88$ (Loeff, 1961); $r = .90$ (Linton, 1952); $r = .92$ (Longnecker 1956); and $r = .95$ (Gardner et al., 1960). Bauman also performed test-retest correlations (3 years) on the EFT and found highly significant correlations of $r = .89$ for men and $r = .89$ for women.

Both the RFT and the EFT together have generally been interpreted as indicants of an individual's ability to ignore; that is, to function perceptually in the presence of a misleading, distracting, or even conflicting context (Witkin et al., 1954, 1962; Witkin, 1950; Adevai et al., 1968; Gardner et al., 1959; Oltman, 1964; Wachtel, 1971; Barrett and Thornton, 1968; Bloomberg, 1965a; Karp, 1963). Those individuals who are relatively "good" on such tasks, who can adjust the rod close to true vertical and/or quickly select the figure hidden in the embedding context, have been termed "field-independent" (FI). Those who exhibit much difficulty on the two measures, who are strongly influenced by the misleading visual surround, have been termed "field-dependent" (FD).

It is on the basis of these two measures, the EFT and RFT, that most of the further work with field dependency has been conducted, although some other measures such as the Draw-A-Person Test have less frequently been employed (Witkin et al., 1954; Adevai et al., 1968b). The many reported relationships

described below, which have been demonstrated between FI and FD differences and so many other perceptual, psychomotor, and personality measures, have thus been based upon the individual's scores on the RFT or the EFT. However, although the existence of a strongly significant relationship between the two tests cannot be argued, there is some controversy over their true equivalence as determiners of the very same perceptual style. It was Witkin (1950) who first proposed the pencil-and-paper EFT, a modification of the older Gottschaldt Figures (1926), as an analogous measure to the behavioral RFT, and in his work he has generally reported very high intercorrelations between the two (e.g., $r = .76$ for men, Witkin et al., 1954, 1967). Nevertheless, a number of other researchers have found much lower correlations. For example, Haronian and Sugerman (1966) and DuPreez (1967) both reported correlations as low as .38 between the RFT and EFT, while even lower correlations ($r = .27$, Crutchfield et al., 1958; $r = .32$, Goodman, 1960) have been reported between the Gottschaldt Figures, the forerunner to the EFT, and the RFT. The most commonly reported intercorrelation between the tests, however, appears to be somewhere between these extremes, approximately .50 (Gruen, 1951, 1955; Bound, 1957; Rudin and Stagner, 1958; Pressey, 1967; Adevai et al., 1968b, Gross and Moore, 1970). To further complicate this problem of EFT-RFT equivalence, the factor of sex may significantly affect these intercorrelations. In their early work, Witkin and his colleagues (1954) were unable to find a significant correlation between the EFT and RFT for females, in contrast to the very high correlation for males mentioned above. However, in a more recent investigation, Witkin, Goodenough, and Karp (1967) reported a rather low, but significant, correlation for college females

between the EFT and RFT ($r = .26, p < .05$). More will be said about sex differences on the EFT/RFT measures later in the paper (Section III).

A further problem with these measures and a factor which probably contributes to the question of EFT and RFT equivalence concerns the numerous forms of both of these tests. For example, the RFT can be administered in three ways, Series I, Series II, and Series III, which differ in regard to the subject's own body position in relation to the frame (Witkin et al., 1954). Series III, however, in which S is vertical and the frame is in the tilted position, has become the most popular and in fact is employed almost exclusively in current research. There are also many commercial versions of the RFT available which can differ from one another in a number of respects, such as the size of rod and frame, distance of target (rod) from subject, illumination level, etc. These commercial RFTs can also differ in being experimenter-operated or subject-operated. Although the correlation between the E-operated and S-operated RFTs is reportedly very high ($r = .83$, Adevalet al., 1968b), it has been suggested as a possible contributing cause to discrepant findings in at least one instance (Vaught, 1970). Furthermore, a rather recent development in this area has been the introduction of a "portable" RFT apparatus (e.g., Oltman, 1968) in contrast to the stationary type originally employed by Witkin. In general, the correlations between the portable and stationary forms of the RFT have been rather high, $r \geq .74$ (Kato, 1965; Morris, 1967; Oltman, 1968; Irving and Henderson, 1971). However, a much lower correlation, $r = .46$, has been reported by Vaught (1969). Although it is true that this rather low correlation between the

two RFTs was probably due to some form of contamination (e.g., light leaks, Irving and Henderson, 1971), it does clearly demonstrate the care that the experimenter must take in administering the RFT in order to reduce external biases or cues and thereby protect the "purity" of the measure. Along these same lines, such confounding procedural as well as instrumental influences as S's head position during trials (Howard and Templeton, 1966; Lester, 1968; Wade, 1970), starting position effects (Werner and Wapner, 1952; Morant and Aronoff, 1966; Lester, 1968), and instructional effects (Mann and Boring, 1953; Lester, 1968) have all been cited as possible factors which can serve to reduce the RFTs validity and reliability.

A somewhat similar problem of comparability arises with the numerous available forms of the EFT. Although the original version employed by Witkin (1950) is still frequently used, its length, as well as the fact that it must be administered individually, has proven somewhat prohibitive in large research projects. To alleviate these problems, alternate forms of the EFT have been developed. Jackson (1956) first shortened Witkin's original EFT by more than 40 per cent and reported correlations between the longer EFT and his short-form EFT in the high .90's. More recently, Jackson and his colleagues (1964) reported the development of five alternate forms of the EFT which differ from one another in being individual or group tests, employing colored or uncolored figures, and requiring or not requiring much memory on S's part. Although the color and memory factors were apparently insignificant in their effects upon the correlations between the group and individually administered EFTs, these correlations

among the five alternate forms ranged between .62 and .84 for males ($N = 52$), and between .56 and .75 for females ($N = 60$). How each of these "parallel" forms is related to the RFT or even to the original EFT has not been reported. One final point which should perhaps be mentioned here for the sake of clarity and completeness is the fact that some versions of the EFT that have been developed are referred to as Hidden-Figures Tests (HFTs) and group administered forms as GHFTs (French et al., 1963). Although the correlation between these HFTs and the EFTs are generally high (e.g., $r = .73$, Evans, 1969), how these HFTs correlate with the RFT is still in question. Indeed, one study has reported a non-linear relationship between performance on a standard RFT and scores on one of the commercially available HFTs (Barrett et al., 1968).

The reason for this rather lengthy review of the RFT and EFT measures themselves--in their many forms--is to clearly demonstrate the multioperational basis of the hypothetically unitary concept of field dependency. The fact that the RFT and EFT are significantly related is not questioned. However, the fact that these measures may also be significantly unlike in tapping slightly different sources of variance has concerned a number of researchers (Elliott, 1961; Thornton and Barrett, 1967; Adeval et al., 1968b; Gross and Moore, 1970; Kurie and Mordkoff, 1970). The possibility that more than a single factor may underlie the perceptual style of field dependency will have to await further research for determination, but the recognition of these "controversial" correlation coefficients among the numerous test forms can serve to caution the researcher in the care he exercises in administering whichever measure of field dependency he

chooses and from overgeneralizing from findings employing any single EFT or RFT form. Of more immediate import, however, is the realization that the empirical investigations and theoretical proposals to be reviewed in this paper, although lumped under the common topic of "field dependency-independency," may or may not in some cases be truly comparable due to the multitude of only hypothetically equivalent test measures. Nevertheless, as Bloomberg (1967) has previously noted, even with such practical problems as these outlined above, the popularity of the field dependency-independency dimension has continued to increase both as a unifying theoretical concept and as a useful research tool in new areas of interest. The following section of this paper will review the numerous reported relationships between this perceptual style and various psychomotor tasks, personality variables, and other perceptual measures.

II. RELATIONSHIPS BETWEEN EFT/RFT SCORES AND OTHER MEASURES

The particular importance and popularity of the perceptual style of field independence-field dependence lies in the fact that, rather than remaining strictly a perceptually descriptive tool, the individual differences on the EFT/RFT measures have been related by a number of researchers to many and sundry other aspects of human functioning. For example, as presented more fully in Appendix A, apparent relationships have been reported between the perceptual differences on the RFT and/or EFT and memory for various types of information, perceptual-motor learning, ability to solve anagrams, autokinetic word writing, body balance, and even driving performance and flying. Within the

more purely perceptual realm itself, the list of purported relationships is even more lengthy. FI Ss have been reported to be superior on the Stroop Color-Word Test, to have higher reversal rates with such reversible figures as the Necker cube, and to have longer spiral aftereffects than FD Ss. In addition, as compared with FD Ss, FI individuals have also been found to demonstrate different eye movements or scanning patterns, less susceptibility to at least one type of visual illusion, but greater reaction to a painful stimulus. Studies within a nonvisual sense modality have reported FD Ss to be poorer on a two-point tactile discrimination task and on a hand/or forehead-traced letter identification task as well as a tactile form discrimination task (tactile EFT). These many relationships between the EFT/RFT measures and various other perceptual phenomena are also more fully outlined in Appendix A, as are the failures to relate this dimension of field dependency-independency to such phenomena as time perception, auditory signal detection ability, and other forms of behavior.

Equally numerous, however, have been the studies that have endeavored to uncover relationships between the FD-I differences among individuals and an underlying personality dimension or character style. Witkin and his co-workers (1962) proposed that the EFT/RFT scores reflected varying degrees of "psychological differentiation" and broadened his original "perceptual style" concept to a "cognitive style," theoretically indicative of more personality-oriented individual differences. In other words, the observable perceptual differences were hypothesized to mirror more central or cognitive differentiation. Some workers in the area (e.g., Witkin et al., 1954, 1962; Crutchfield et al., 1958; Elliott,

1961) have attempted general personality descriptions of the FI and FD individuals on the basis of numerous tests, observations, and interviews. For example, Crutchfield and his colleagues (1958), following just such extensive testing and observation of 100 Air Force personnel and in a rather literary fashion described the FI members of their sample as original, demanding, individualistic, masculine, and strong. Witkin (1962), however, has taken great pains to emphasize that such a onesidedly positive view of the FI individual is not completely accurate and that the psychiatric hospitals are populated equally by FI and FD patients. (More will be said of the relationship of personality pathology to the FI-FD differentiation later in this section.)

Beyond these more general, and probably artificially extreme, descriptions of the FD and the FI person, researchers have reported apparent relationships between EFT/RFT scores and such specific personality characteristics as rigidity (Breskin and Gorman, 1969; Witkin et al., 1954, 1962; Gardner et al., 1959), creativity (Bieri et al., 1958; Spotts and Mackler, 1967; Ohnmacht and McMorris, 1971; Bloomberg, 1967), impulsivity (Bloomberg, 1965; Willoughby, 1967), suggestibility (Sanguilliano, 1951), social orientation (Minkowich, 1965; Fitzgibbons et al., 1965, 1966; Eagle et al., 1966), and the form or nature of child rearing and early life experiences (Minkowich, 1965; Witkin, 1966, 1969; Witkin et al., 1962; Dyk and Witkin, 1965; Kagan and Kogan, 1970). Although some researchers have reported success in relating the perceptual differences to the rather popular cognitive dimension of extraversion-introversion (Taft and Coventry, 1958; Kato, 1965; Corcoran, 1965; Evans, 1967; Corbin, 1970; Kennedy,

1971; Fine and Cohen, 1963), others have been unsuccessful (Franks, 1958; DuPreez, 1967).

A fairly extensive body of literature also exists relating the EFT/RFT form of perceptual differentiation to sensory deprivation research. For ease of discussion it is possible to separate these studies into two general categories: those demonstrating the differential effects of a sensory deprivation condition upon FD vs FI Ss, and those concerned with the effects of the isolation upon EFT or RFT performance. In the former case, there seems to be good agreement among researchers that the FD Ss are more disturbed or "aroused" by the deprivation setting, as indicated both by verbal reports from the Ss (Silverman et al., 1961; Cohen et al., 1962) and by such physiological indices as increased GSR activity and decreased alpha EEG activity (Cohen et al., 1962; Silverman et al., 1961; Zuckerman, 1968). Furthermore, the FD Ss were reported to have a higher incidence of visual and auditory imagery, greater disruption in their thought processes, larger distortion of the time-sense, and great physical discomfort than the FI Ss (Cohen et al., 1962; Silverman et al., 1961; Murphy, 1966). It also appears that a rather important factor in these deprivation effects is the degree of "structure" allowed by E. The more uncertain the Ss are concerning the nature of the experiment itself or its various conditions, the more dramatic are these FD-FI differences. Through increased familiarity with the experiment (not necessarily the deprivation condition itself) and/or very detailed explanatory instruction by E, these differences may well disappear (Zuckerman, 1968; Culver et al., 1963).

Concerning the effects of sensory deprivation on the EFT and RFT measures themselves, it appears that the crucial factor may well be which particular test of field dependency-independency is employed (Zubek, 1969). Although Culver and his associates (1963) found no effect following a 2-hour deprivation period, Heron (1961) reported impaired EFT performance following a prolonged deprivation condition. RFT performance, on the other hand, has been reportedly improved by the isolation condition (Jacobson, 1966; Kurie and Mordkoff, 1970). It has been proposed by Kurie and Mordkoff (1970) that the effect of the deprivation may have been to render Smdore aware of his bodily sensations and thereby improve his RFT performance, which to some extent may depend upon "somatic concentration" in the visually conflicting setting.

A large number of studies have also investigated the possibility of perceptual style differences being related to personality pathology. Although there is apparently no relationship between the field-dependency measures and scores of neuroticism, such as obtained on the Maudsley Personality Inventory and other such scales (Bound, 1957; Franks, 1957; Taft and Coventry, 1958; Evans, 1967; DuPreez, 1967), work with particular psychosomatic problems and personality disorders in the general population and in hospitalized psychiatric patients has proven very fruitful. Silverstone and Kissin (1968) found hypertensive Ss to be significantly more FI than peptic ulcer patients, while Pardes and Karp (1965) reported obese individuals to exhibit marked field dependency. Fishbein (1963) also found high field dependency with asthmatic children. Concerning the

hospitalized patients, Witkin and his colleagues (1954, 1965) and others (Silverman and Cancro, 1968) have reported a greater preponderance of extreme FD and FI Ss in a psychiatric population than in a normal college population. In contrast, a few studies have reported that psychiatric patients as a group are more FD than college samples (Johnson et al., 1970; Neville et al., 1969). However, these latter results may have been due to the select type of patient in the particular institution surveyed, for there is also evidence that the type of disorder exhibited by the FI S differs markedly from that of the FD S (Witkin et al., 1954, 1962; Witkin, 1958, 1965; Adeval et al., 1966). Therefore, if an institution were more likely to accept a certain "type" of patient (e.g., depressive vs paranoid), a greater number of FD scores might then be found among the patients tested. The Neville et al. study (1969) has furthermore been criticized on the basis of a number of possible methodological or procedural problems, such as the "home-made" RFT which was employed (Vaught, 1970). Vaught (1970) has furthermore criticized the Neville et al. study (1969) on the basis of a number of possible methodological or procedural problems, such as the "home-made" RFT which was employed.

There is one final area of personality disorder that has been reported to bear some relationship to field-dependency measures: alcoholism. It has been found that alcoholic patients are significantly more FD than either non-alcoholic patients or the general population at large (Rhodes and Yorioka, 1968; Karp et al., 1963, 1965; Witkin et al., 1959, 1962; Bailey et al., 1959; Karp and Konstadt, 1965). The subsequent question has arisen as to whether the FD

individual is more likely to take up drinking than the FI individual or whether drinking itself causes a shift in one's perceptual style toward field-dependency (i.e., poorer scores on the EFT and RFT). Witkin apparently favored the first possibility. He has stressed the fact that a certain personality "type" (i.e., dependency problems, poor body image, stress-sensitive) has been found among alcoholics, whether they be current drinkers or abstainers (Witkin, 1965; Witkin et al., 1962). In support of the latter hypothesis, however, Witkin and his co-workers (1962) have reported that alcohol renders the S more FD, and Bailey et al (1961) have hypothesized that it is the physiological effect of the alcohol on the brain which caused the increased field-dependency exhibited by alcoholics. Furthermore, Goldstein and Chotlos (1966) reported an increase in field-independency among an alcoholic population following 8 to 10 weeks of treatment. Following this argument and based upon their findings that the FI individual was superior in an emergency driving situation, Barrett and Thornton (1968) proposed that the positive relationship between drinking and driver accidents may in part be due to an alcohol-induced reduction in the individual's FI abilities, rendering him less able to visually extract the dangerous element from its complex environmental context.

III. THEORETICAL BASES FOR FD-FI DIFFERENCES

Attempting to collate these many empirical relationships described above into a single, unified theoretical structure, many theorists and researchers have come to employ the more general terms "cognitive style" or "cognitive control"

in place of the older, more specific and perceptually bound "perceptual style" in reference to the field dependence-independence dimension. As mentioned previously, Witkin and his colleagues (1962) have considered the perceptual EFT/RFT measures to be indicants of a more pervasive degree or level of "psychological differentiation" within the individual which, in turn, has resulted in the observed perceptual differences in field articulation. More than just a perceptual mode adopted by an individual in a specific visual test situation, this "cognitive style" of field dependency has been purported to reflect the individual's particular manner of interacting with his environment, perceptually, motorically, and motivationally. Therefore, although there has been some rather extensive criticism of the proposed generality of this "field articulation approach" (Zigler, 1963a, 1963b; Bloomberg, 1967; Sherman, 1967; Rudin, 1968; DeFazio and Moroney, 1969), the popularity of the theoretical umbrella as well as the empirical approach or tool presented by the field dependency-independency concept has continued to increase.

In contrast to this general trend in the literature relating the perceptual behavior on the RFT and EFT to other perceptual tests and personality factors, a few theorists and researchers have investigated this perceptual differentiation from a more reductionistic standpoint. A number of studies have reported physiological differences, generally in terms of arousal, between FD and FI SS. However, as previously noted by Morf, Kavanaugh, and McConville (1971), many of these studies apparently have found contradictory results concerning the nature of the relationship between arousal level and RFT/EFT performance. It

has been reported in the literature that increased arousal leads to both improved RFT/EFT scores (e.g., Oltman, 1964, 1969) as well as to a decrement in these same measures (e.g., Stern and Plapp, 1969). Before an attempt is made to deal with this apparent contradiction, the studies supporting both contentions will first be reviewed.

Callaway (1959) reported that the effect of drug-induced arousal upon Jackson's short-form EFT was to improve performance (i.e., S became more FI). Similarly, Oltman (1964) demonstrated that his Ss also became more FI, as measured on the RFT, under an arousing condition (very loud white noise). On the basis of his own and Callaway's earlier finding, Oltman hypothesized that perhaps the entire field-dependency continuum in turn rested upon a more fundamental continuum of physiological arousal. Another basis for Oltman's theorizing concerned the fact that a rather extensive body of literature already existed at that time which supported the notion that, under arousal, an individual suffers a restriction in his perceptual range of sensory input (e.g., Bahrick, Fitts and Rankin, 1952; Easterbrook, 1959; Callaway, 1959, 1964; Callaway and Thompson, 1953; Bursill, 1958; Venables, 1963, 1964). In other words, the immediate effect of an arousal or stress situation appeared to be a focusing or narrowing of the individual's perceptual field and, hence, a reduction in the amount of environmental stimuli to which he can attend. A number of studies subsequent to those of the early sixties have generally supported this proposed arousal-induced perceptual restriction upon which Oltman partly based his hypothesis (e.g., Wachtel, 1968; Weltman, et al., 1966, 1971; O'Malley and Pop-

lawski, 1971; Long and Mo, 1971). Oltman's hypothesis then maintained that this restriction caused a perceptual focusing by S to certain aspects of his perceptual environment, thereby rendering the distracting contextual surround less effectual. As described previously, Witkin's tasks for determining the degree of field dependency, both the RFT and EFT, have generally been described as requiring the individual to overcome (i.e., ignore) the misleading visual cues of an embedding context or, conversely, to selectively attend to the relevant stimuli presented in a distracting surround (e.g., Adeval, et al., 1968; Barrett and Thornton, 1968; Bloomberg, 1965; Gardner et al., 1959). Therefore, the FI individual, as a hypothetically more physiologically aroused individual, may simply be demonstrating his greater arousal-induced perceptual focusing on both the EFT and RFT, which thus results in his superior performance on those measures.

This proposed physiological (arousal) basis for the EFT/RFT difference among individuals was not completely original with Oltman (1964). Witkin (1959, 1962) had suggested that constitutional differences might also be important as determinants of perceptual style, but he apparently preferred the more cognitive or personality-related interpretations. A survey of the literature amply demonstrates that this has been the most popular approach to the FD-FI differences. Although there has been some criticism of Oltman's 1964 findings (Hayes and Venables, 1970; Vaught and Bremer, 1967; Vaught, 1969), there has also been some increasing evidence in favor of his arousal interpretation. Hein and his co-workers (1965) and Wortic (1964) reported that FI Ss exhibited significantly

greater and more prolonged GSR responsivity to negatively reinforced (shock) colored lights and also demonstrated greater GSR discriminability to the shock-paired lights than did the FD Ss. In a heart-rate conditioning paradigm, Hein and his colleagues (1968) reported differing acceleration-deceleration patterns in the FD vs FI Ss, indicative of possible autonomic nervous system (ANS) differences between the two perceptually dichotomized groups. Similarly, Courter and his associates (1965) found that, in comparison with FD Ss, FI Ss were significantly better able to discriminate between a conditioned auditory signal and unreinforced signals by the amplitude of their GSR. Furthermore, as a result of their findings, they proposed that the FD individuals may possess a less well-differentiated ANS than the more GSR discriminative FI Ss.

Possible indirect support for this arousal interpretation of FD-FI differences has also been reported from two other lines of research involving the EFT/RFT scores: sex differences and age or developmental factors. A large number of studies have found significant sex differences on the EFT/RFT measures, women generally scoring more FD than men (e.g., Witkin, 1950; Witkin et al., 1954, 1962; Kato, 1965; DeRussy and Futch, 1971; Bennett, 1956; Fiebert, 1967; Morf et al., 1971; Bieri et al., 1958; Wolf, 1971). Many researchers have attempted to treat these observed sex differences on the EFT and RFT as due to general cultural influences upon the sexes (Iscoe and Carden, 1961; Sherman, 1967; Vaught, 1965, 1971a, 1971b). However, Broverman and his co-workers (1968) have rejected the so-called "cultural reward hypothesis" (i.e., sex typing) as the underlying basis for the observed perceptual differences between men

and women in favor of a physiological explanation. They have proposed that the sex differences exhibited on many psychomotor and perceptual tasks, including those for field dependency-independency, are due in fact to a different general bodily balance existant between the adrenergic and cholinergic processes in the male and female because of the gonadal steroid sex hormones present. It was hypothesized that the hormones, androgens and estrogens, influence this relationship between the adrenergic-activating and cholinergic-inhibitory neural processes in such a way as to result in the many reported sex differences in cognitive abilities, EFT/RFT measures included. In effect, Oltman's earlier proposal had simply gone one step further and had hypothesized that, although men as a group may be more autonomically aroused (adrenergic active) than women, within the sexes individuals will also differ on the a continuum of autonomic arousal level (adrenergic/cholinergic balance). It was a physiological continuum of this nature which Oltman (1964) originally proposed underlay performance on Witkin's tests of field dependency-independency. Due to the concomitant continuum of perceptual focusing, individuals demonstrate various levels of proficiency on the EFT and RFT measures.

The numerous studies investigating the effects of age upon the EFT/RFT measures may also be indirectly supportive of an arousal interpretation. If it is true that the autonomic differences, which are believed by some to underlie the perceptual differences between the sexes, are in turn due to the variant hormonal levels in the males and females as proposed by Broverman and his co-workers (1968), reduction in the variance of these levels should result in a concurrent

reduction in the discrepancy of perceptual performance. It may be possible to treat the apparent age effects upon field dependency in this manner. Witkin (1959, 1967) and Wolf (1971) reported that studies with prepuberal boys and girls have not demonstrated the consistent and stable sex differences generally found with mature men and women. It is approximately at the age of sexual puberty that the sex differences in both RFT and EFT performance first become clearly noticeable. This may perhaps be due to the changing hormonal levels of the adolescent at this time. Furthermore, there is also some evidence that in old age, when the hormonal levels again are altered, not only do both men and women tend to become more FD, but also the sex differences on the tests of field dependency once again disappear (Karp, 1966, 1967; Schwartz and Karp, 1967; Axelrod and Cohen, 1961; Comali, 1965).

Concerning such a possible relationship between field dependency-independency and general arousal, Morf, Kavanagh, and McConville (1971) previously noted that many of the studies relating physiological (arousal) differences to FD-FI Ss were apparently contradictory in their findings. In contrast to Oltman's (1964) and Callaway's (1959) findings reported above, some researchers have noted that increased arousal or ANS reactivity was also a characteristic of FD Ss (Gross, 1959; Morf and Howitt, 1970). In a condition of sensory deprivation, FD individuals have been found to show more spontaneous electrodermal responses (EDRs) than FI Ss (Silverman et al., 1961; Cohen et al., 1961, 1962). Block (1957) reported that FD Ss had a greater frequency of EDRs in a lie situation than did FI Ss. In addition, Pillsbury and his co-workers (1967) found a

significant correlation between the number of particular EEG responses and RFT scores, while Hustmeyer and Karnes (1964) reported a significant correlation between the number of spontaneous EDRs and the time taken on the EFT. Studies such as these appear strongly contrary to the arousal-field independency relationship formulated above.

In their attempt to deal with this apparent contradictory evidence relating both independency and field dependency to arousal, Morf and his colleagues (1971) suggested that perhaps these divergent findings were the result of a curvilinear (inverted-U) relationship between the factors. In other words, perhaps an increase in arousal up to a point resulted in an improvement in RFT/EFT performance such as Oltman reported (1964), but a further increase caused a performance decrement on the same perceptual tasks as Block found (1957).

It is possible, however, that an alternative explanation of this discrepancy may lie with the particular nature of the physiological measures employed in the two types of studies. Those studies relating particular arousal measures to field independence (e.g., Courter et al., 1965) dealt more specifically with ANS arousal level and utilized such measures as amplitude or length of GSR. However, the studies relating arousal to field dependence (e.g., Silverman et al., 1961) employed such arousal measures as frequency of GSR or number of EEG responses and may, therefore, have dealt more directly with ANS stability. In other words, the FD S may have a more labile ANS but be functioning at a lower ANS level than FI Ss; while, conversely, the FI S may be

more ANS stable but have a higher ANS level than his FD counterpart. Furthermore, this distinction between ANS arousal level and ANS stability is not new or arbitrary within the field of psychophysiology. A rather extensive amount of research has been conducted into both these "properties" of the ANS and will be briefly reviewed below.

With regard to level of arousal, for over 30 years Wenger and his co-workers (1941, 1942, 1943, 1947, 1948, 1956, 1957, 1962, 1965, 1966) have been investigating this very concept of a continuum of physiological arousal level. Through the use of factor analysis, they have derived a single measure, \bar{A} , which is hypothesized to represent the individual's sympathetic-parasympathetic ANS balance. This \bar{A} score, in turn, is based directly upon the differently weighted physiological measures of palmar skin conductance, heart period, salivary output, blood pressure, temperature, and other such measures of ANS functioning. Individuals have been found to differ in the basic level of their ANS functioning as measures by this \bar{A} score. Very high \bar{A} scores are considered indicative of extreme parasympathetic dominance and very low scores of extreme sympathetic functioning, with the largest number of individuals falling somewhere in between these extremes. In the series of studies referred to above, Wenger and his colleagues also demonstrated that the individual \bar{A} scores were consistent and reliable in both children and adults and for men and women over relatively long periods of time (years).

Although there has been no direct attempt as yet to relate Wenger's \bar{A} measures to Witkin's field dependency-independency scores, there appears to be much intuitive appeal for this theoretical connection. Both measures, when taken on relatively large samples of persons, fall into normal distributions on their respective continuums. Both the \bar{A} scores and the EFT/RFT scores exhibit marked sex differences (Witkin et al., 1954, 1962; Wenger, 1941). Whereas Oltman (1964) demonstrated that, under arousal, an individual becomes more FI, Smith and Wenger (1965) reported a shift in S's \bar{A} measure toward more sympathetic dominance under an arousal condition. Similarly, while the physiological response to such drugs as insulin and amphetamine has been found to differ for FD and FI Ss (Cohen et al., 1962; Harman et al., 1966; Silverman et al., 1963, 1967; McGough et al., 1965; Reckless et al., 1962) Wenger's entire theoretical scheme originated from his interest in the earlier work of Eppinger and Hess (1915) that had reported individual differences in drug reactions. More recently, Wenger and his associated (1960) have also investigated the effects of specific drugs (e.g., epinephrine) upon individual \bar{A} scores.

The final argument in support of a Witkin-Wenger relationship concerns the numerous studies involving Witkin's EFT/RFT measures or Wenger's \bar{A} and various forms of pathology. Although at first inspection of reported \bar{A} scores among neurotics, psychotics, and psychosomatics it may appear that these scores are all relatively low (i.e., SNS dominant) in comparison with "normative" groups (Wenger, 1966), these normative groups may not in fact be truly comparable to the patient subgroups, since they are composed of Army

Air Force (AAF) personnel or relatively small college samples. Such individuals quite probably differ in age, IQ, and other respects from many of the patients. However, if one takes the mean \bar{A} of all these patient groups with which to compare the separate categories of illness, many of the previously mentioned field dependency-independency relationships are mirrored. Paranoid patients, reported by Witkin and his colleagues (1954, 1962, 1965) to be relatively FI, generate \bar{A} scores much lower than this mean \bar{A} measure (i.e., high SNS dominance; Wenger et al., 1965). Similarly, peptic ulcer patients whom Gordon (1953) reported to be generally FD are above the mean \bar{A} score for all psychosomatic patients, indicating comparatively high PNS dominance among the psychosomatic illnesses (Wenger, 1948, 1966; Little, 1955). In a 1964 follow-up to work done on AAF students in WWII, Wenger was able to match reported disorders with obtained \bar{A} scores. In that study, those individuals who reported asthma had higher \bar{A} scores than individuals with no reported disorders (Wenger, 1966). This is of interest in light of an earlier study by Fishbein (1953) in which asthmatic children were found to be relatively FD as a group. Unfortunately, much further work involving Wenger's measure of autonomic balance and psychiatric and psychosomatic patients (Wenger, 1966) has no comparable research with the EFT/RFT scores. The studies just described, however, do support the theoretical connection between field independence and relatively lower \bar{A} scores and between field dependence and relatively higher \bar{A} scores.

It can be seen, then, that this theoretical connection between Witkin's perceptual measures and Wenger's autonomic measures is rather strong. However, the evidence cited above is all of an indirect nature, and more direct investigations into this hypothesized relationship must be conducted before a more complete acceptance of the theory can be made.

Concerning the stability of the ANS, Lacey and his co-workers (1958, 1959, 1967) investigated the relationship between an individual's ANS stability, as measured by the frequency of GSR "bursts" and heart rate changes, and such differing variables as physiological response to shock, level of frustration tolerance, personality "types," and complex reaction time (RT) performance. Williams and his associates (1965) were basically able to replicate the Lacey's earlier findings (1958) on a complex visual-motor test, performance on which was found to differ significantly for ANS labile and stabile individuals. Krenek (1970) also replicated the findings concerning ANS stability and RT and in a later study demonstrated a relationship between the stability measures and several indices of driving behavior, such as steady-state car following, open-road-constant-speed driving, and transient car following (Krenek, 1971).

Furthermore, it is of interest to note that both in the general personality descriptions of the stabile vs labile individual offered by Lacey and Lacey (1958), as well as the driving performance of one vs the other (Krenek, 1971), the labile (high spontaneous GSRs and cardiac responses) individual sounds very similar to the FD person described previously. The stabile indi-

vidual appears to fit more the FI description. As mentioned earlier, such terms as "cold," "distant," "isolated," "overcontrolled" have been used to refer to the extreme FI personality; "social," "dependent," "affable" and the like to the FD personality (Crutchfield et al., 1958; Witkin et al., 1954, 1962). In a similar manner, the stable individual has been described as "repressed," "emotionally stable," "placid," and "lacking affect;" the labile as "anxious," "overly reactive," "talkative," and with wide fluctuations in mood (Lacey and Lacey, 1958). Hence, there is some mildly supportive evidence for an apparent parallelism between the FI and the stable personality and between the FD and the labile personality.

Concerning driving performance, Krenek (1971) reported the physiologically stable individual to be superior to the labile on the driving behavior mentioned above. As indicated in Appendix A, the FI individual has also been found a superior driver as compared to the FD person (Barrett and Thornton, 1968; Harano, 1970). It appears then that good driving ability is a common characteristic of both ANS stable and FI individuals.

To briefly summarize the distinction being proposed here, it appears that the studies relating field independence both to increased (or at least higher) and decreased (or at least lower) arousal may not in fact be contradictory. The former studies, which reported a relationship between field independence and arousal, employed physiological measures akin to those used by Wenger and his associates in differentiating individuals according to arousal level. The latter studies, relating field dependence to arousal, employed

physiological measures more similar to Lacey's', which, in turn, have been viewed as indicants of S's ANS stability. And at the present time there is no evidence to indicate that an ANS labile individual necessarily falls at any specific level on Wenger's arousal level continuum or vice versa. Therefore, the attempts to examine the physiological basis of the perceptual style, rather than resulting in a series of contradictory studies, may have simply uncovered relationships with more than a single physiological dimension. Figure 1 represents a theoretic attempt to describe the possible interrelationships between the FD-FI differences and the orthogonal physiological measures of ANS stability and ANS level. From the figure it can be seen that FD Ss are generally higher on Wenger's \bar{A} scale (more parasympathetic dominant) and more labile on Lacey's stability dimension. In contrast, the FI Ss appear as relatively ANS stable but also relatively low \bar{A} (high arousal level) individuals. As outlined above, present experimental evidence relating ANS functioning to field dependency-independency supports such a hypothetical description.

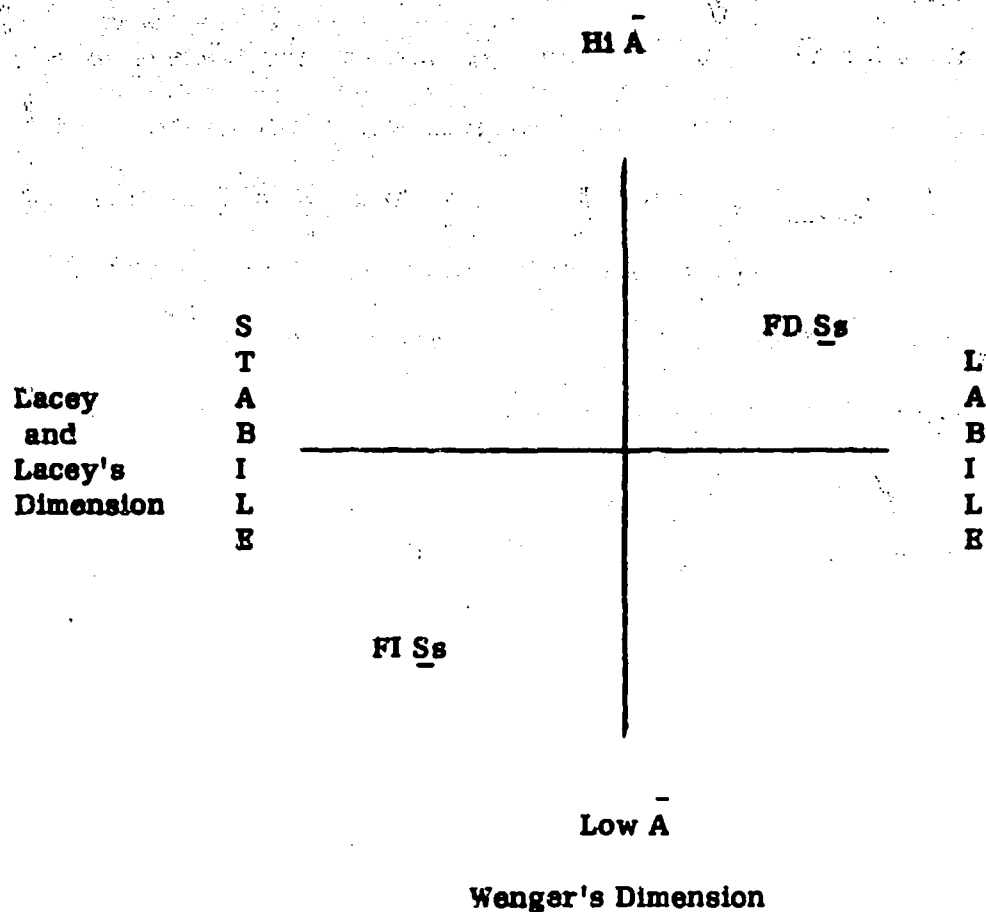


Fig. 1. Theoretical Relationship between Wenger's \bar{A} , Lacey's Stability, and Field Dependence-Independence.

IV. THE EFT AND RFT AS PRACTICAL RESEARCH TOOLS

Whatever the actual basis for this perceptual differentiation demonstrated among individuals, be it central, physiological, or an interaction of the two, the continuum of field dependency-independency itself remains of importance as a discriminative tool of individual performance in a number of situations of all levels of complexity. As described above, performance on the RFT and/or EFT has been related to individual differences in many spheres of human activity,

The FD-FI differences appear then to reflect a pervasive dimension within human behavior which, in turn, extensively contributes to the variability of much of human performance. Furthermore, this "performance" does not just involve laboratory tasks of a very elementary perceptual or psychomotor nature. Many relatively complex forms of behavior described previously have been shown to be related to these field dependency-independency differences.

Rather recently, there seems to have developed somewhat of a trend toward the use of the EFT and RFT as tools, or methods, or techniques to be used in the investigation of more practical, everyday phenomena, such as driving, academic achievement, and occupation selection. For example, Barrett and Thornton (1968) and Harano (1970) have related superior driving performance to FI individuals. Furthermore, on the basis of their findings, Barrett and Thornton (1968) attempted to reinterpret many of the known factors related to driving performance (e.g., alcohol, age, sex) in light of the reported relationships between these same factors and the EFT/RFT measures. Perhaps even more interesting is the practical suggestion they make concerning the use of the RFT to screen individuals interested in occupations requiring a large amount of driving.

An analagous suggestion was proposed by Kennedy (1972) concerning Naval aviation personnel. As hypothesized, Kennedy (1972) found that field independence was related to success in aviation training for both pilots and non-pilots. These findings were consistent with a number of other studies that reported superior performance by FI Ss on various pilot-simulating, pilot-

related, or pilot-selective tasks (Benfari and Vitale, 1965; Thornton et al., 1968; Barrett and Thornton, 1968; Crutchfield et al., 1958). Furthermore, Cullen and his colleagues (1969) found their sample of 149 experienced commercial pilots to be significantly more FI than a sample of engineers. Engineers, in turn, had been found to be significantly more FI than a general college sample (Barrett and Thornton, 1967). Within such a college sample, it has further been reported that students majoring in liberal arts are more FD than those majoring in math, physics, and chemistry (DeRussy and Futch, 1971). Studies such as these reflect very practical or applied relationships uncovered between the EFT/RFT measures and a wide range of human behaviors.

Concerning these relationships between RFT/EFT performance and such "real-world" behavior as driving, flying, and even occupation, the problem of the actual stability of these measures arises, beyond the rather simple test-retest or odd-even reliability of the measures already reported. If a practical use is to be made of the FD-FI differences, such as Kennedy (1972) suggested for the selection of naval aviators and Barrett and Thornton (1968) for drivers, the implicit assumption is apparently maintained that these EFT/RFT scores are affected little by later individual experience. In other words, if it is to be of useful predictive validity, the determination of an individual's degree of field dependency or independency at any particular moment in time must result in a stable, unchanging measure indicative of his "true" field dependency throughout his lifetime. For example, Barrett and Thornton (1967) interpreted their findings that engineers were more FI than a normal college sample as being

due to a selective screening process within engineering programs that effectively eliminated those individuals who were too FD. They proposed that the nature of the work within the engineering profession "required" the perceptual characteristics of the FI individual, and hence effectively "weeded out" those who lacked them. The superior RFT performance by the engineers was not believed to be due to any particular training peculiar to the engineering profession. Had the engineers in their study been tested as students or even young children, Barrett and Thornton would assume that the higher indices of field independence would still have been determinable. DeRussy and Futch's findings (1971) that within a college sample the more scientific-oriented students were also more FI, a factor which they suggest could aid in student guidance, can be interpreted similarly. FD individuals may simply find the scientific curricula too demanding.

The alternate explanation that such curricular can perhaps shift an individual toward field independency is also possible. Similarly, the engineer's work may "train" him to function in an FI manner. This possibility was in fact proposed by Cullen and his associates (1969) concerning their extremely FI airline pilots. They described the pilot's occupation as frequently requiring the individual to overcome potentially distracting elements or cues and deal analytically with but a single crucial factor in the situation. They then suggested that perhaps this actual flying experience may have served to directly improve the FI perceptual performance of the pilot on the RFT.

There are, however, some theoretical and empirical objections to this training-related interpretation of FD-FI differences between occupations. First of all, it is rather difficult to incorporate such drastic training effects upon the field dependency continuum within either the personality-grounded or the physiological explanations of the phenomena described previously. Both the personality- and the physiological-oriented researchers have considered the perceptual differentiation as a relatively pervasive and unchanging characteristic of the individual. Furthermore, Witkin and his colleagues (1965, 1967) have described their own and a number of others' work, demonstrating the invariance of the EFT or RFT scores of differentiation under a variety of natural (e.g., age, marriage, divorce) and experimental (e.g., drugs, electro-convulsive shock, hypnosis) conditions. Studies concerning the direct effects of learning on the measures of field dependency-independency have also supported the stability of the perceptual differences demonstrated on the EFT and RFT. Although the knowledge of results inherent in the EFT have resulted in reports of a significant practice effect improving performance (Witkin et al., 1954, 1967; Goldstein and Chance, (1965), the RFT, which involves no knowledge of results, has been found to demonstrate no such learning or practice effect (Witkin, 1948; Witkin et al., 1954, 1967; Wilf, 1965; Vaught, 1971). In other words, even extended experience with the RFT apparatus itself has not been found to result in a shift toward field independency (i.e., improved performance.) In addition, Elliott and McMichael (1963) attempted to improve S's RFT performance through direct instructional aids and practice on the apparatus, but were unsuccessful beyond more than a transient, short term effect. To briefly summarize, then, the

stability of the perceptual differences has been found over long periods of time, after significant events in the person's natural lifetime, and even in the face of strenuous experimental attempts to bring about change.

CONCLUSION AND IMPLICATIONS

This survey was undertaken because of the increasing interest in and popularity of the major field dependency indices, the EFT and RFT. This growing interest and popularity in recent years of the two measures has evolved to a large extent from the mounting evidence in the literature which strongly indicates that these measures may be useful tools in the investigation of very practical problems, such as the prediction of success in aviation training reported by Kennedy (1972). Before extensive work was undertaken with the EFT and RFT by this Laboratory, however, it was deemed appropriate to survey the state-of-the-art regarding Witkin's concept to ensure against the possibility of "rediscovering the wheel" as well as to determine the most appropriate direction such work should take.

On the basis of this review, it appears that the FD-FI differentiation, as reflected in the scores on the EFT and RFT, is a phenomenon observable early in life which remains a relatively unchanging and enduring discriminative characteristic of the individual's behavior throughout the remainder of his lifetime. As outlined extensively in the earlier sections of this paper, this perceptual differentiation has been related to individual differences in many spheres of human activity, perceptual, personality, and psychomotor. Although the actual

basis (or bases) for these perceptual differences is still in question, this does not necessarily invalidate or inhibit either the practical use of the RFT and EFT or the theoretical value of the field dependency-independency concept. The fact that the underlying "cause" of these differences is not completely known (physiological? or experiential?) does not negate the multitude of empirically determined relations between these tests and the myriad forms of behavior mentioned above.

Perhaps a more serious problem for these measures and the differentiation concept in general, however, concerns the many available forms of these tests and numerous possible biasing factors described early in this report. The actual comparability of the many EFTs and RFTs, not to mention some of the other less common but still employed measures of field dependency-independency, as equivalent indices of the same behavioral phenomena is a serious research question which must await further work for determination. Nevertheless, the overwhelming frequency of studies reported in current literature, including the numerous replications evidenced throughout this paper, which involve either the tools or the concept itself of field dependency-independency, testifies strongly to its present popularity--and to a degree, perhaps also its validity.

On the basis of this review of the field dependency-independency concept, a series of studies are planned (some have already been initiated) within the Naval Aerospace Medical Research Laboratory (NAMRL) which directly

involve the EFT and RFT measures. Appendix B contains a brief description of some of these proposed studies.

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Appendix A
Reported Relationships Between EFT/RFT Scores
and Other Perceptual-Psychomotor Tasks

VISUAL ILLUSIONS

| Investigator(s) | Measure of Field Dependency-Independancy | Behavioral Variable(s) | Results |
|---|--|---|---|
| Gardner (1957) (abstract) | (unstated) | "Three classical visual (line) illusions" | Field dependent S_d were more susceptible to these illusions. |
| Crutchfield, Woodworth, and Albrecht (1958) | RFT and Gottschaldt Figures Test | Size-weight illusion | Field dependent S_d were more susceptible to this illusion (i.e., they had significantly larger mean estimates). |
| Gardner (1961) | EFT | Mueller-Lyer figure | Both the EFT and the line illusion were found to load on the same factor of "field articulation." |
| Pressay (1967) | EFT and RFT | Poggendorf illusion | For males, there was a significant relationship between the degree of illusion and both EFT and RFT scores ($r = .44$ and $.39$, respectively, $p < .05$). For females only the EFT was significantly related to the illusion ($r = .55$, $p < .01$). |
| Vaught and Hunter (1967) | RFT | Autokinetic word writing (S_d told that a stationary light actually traces out words) | Field independent S_d were quicker to respond than field dependent S_d on this imaginary word tracing task. |
| Pressay and Koffman (1968) | EFT and RFT | Poggendorf illusion | No relationship was found between either EFT or RFT performance and susceptibility to the illusion. |
| Casero and Voith (1969) | EFT and RFT | Autokinetic test (amount of reported movement of stationary light) | No relationship was found for either men or women between the field dependency measures and the degree of reported movement. |
| Byth and Pearn (1972) | EFT | Delboef illusion | No relationship was found between EFT scores and the magnitude of the perceived illusion. |

VISUAL AFTEREFFECTS

| Investigator(s) | Measure of Field Dependency-Independence | Behavioral Variable(s) | Results |
|----------------------------|---|---|---|
| Immergluck (1966a) | RFT | Perceived distortion in figure(s) following exposure to an initial figure(s) (i.e., amount of figural aftereffect). | Field independent <u>Ss</u> exhibited more potent aftereffects than did field dependent <u>Ss</u> . |
| Immergluck (1966b) | RFT | (Same as above) | (Same as above) |
| Immergluck (1966c) | RFT | (Same as above) | (Same as above) |
| Immergluck (1968a) | RFT | (Same as above) | (Same as above) |
| Pressay and Koffman (1968) | EFT and RFT | (Same as above) | These authors were unsuccessful in their attempt to replicate the above studies. |
| Immergluck (1968b) | -- | -- | Immergluck replies to the above study. |
| Pressay (1968) | -- | -- | Pressay replies to Immergluck's article above. |
| Dodwell (1969) | -- | -- | Dodwell enters the Immergluck-Pressay controversy by commenting on the importance of E-induced set factors in figural aftereffect research. |
| Immergluck (1970) | RFT | (Same as above) | Field independent males and field independent females exhibited significantly more aftereffect responses than did field dependent males or females ($p < .01$). |
| Byth and Pearn (1972) | EFT | (Same as above) | These authors were unable to replicate Immergluck's findings using a slightly different procedure for determining degree of figural aftereffect. |
| Anderson and Ruuth (1971) | RFT | Amount of spiral aftereffect perceived by children after viewing a black-on-white arithmetic spiral. | Intermediate scores on the spiral aftereffect were also found to fall in the middle range on the RFT. |

REVERSIBLE FIGURES

| Investigator(s) | Measure of Field Dependency-Independancy | Behavioral Variable(s) | Results |
|--|---|---|--|
| Newbigging (1954) | EFT | Reversal rates on three reversible figures | Under instructions to reverse as rapidly as possible, field independent <u>Ss</u> were found to have higher reversal rates. |
| Jackson (1955, 1958) (cited in Witkin et al., 1954) | EFT | Reversal rates on reversible figures | Under instructions to resist spontaneous alternations, field independent <u>Ss</u> were found to have lower reversal rates. |
| Bloomberg (1965a) | EFT | Reversal rate on figure described by Corah (1962) | In an initial 2-minute period, field independent <u>Ss</u> reported more spontaneous figure reversals than field dependent <u>Ss</u> . |
| Haronian and Sugerman (1966) | EFT and RFT | Reversal rate on Necker cube | Under instructions to resist spontaneous alternations on the figure, field independent <u>Ss</u> had lower reversal rates than field dependent <u>Ss</u> . Under neutral instructions no differences were found. |
| Immergluck (1966b) | EFT | Reversal rates on a series of reversible figures | Field independent <u>Ss</u> demonstrated higher reversal rates on the reversible figures than did field dependent <u>Ss</u> . |

STROOP COLOR-WORD TEST*

| Investigator(s) | Measure of Field Dependency ¹ -dependency | Behavioral Variable(s) | Results |
|----------------------------|--|---------------------------------------|--|
| Smith and Klein (1953) | EFT | Stroop Color-Word Test (Stroop, 1935) | Field independent Ss were found to be superior on this "interference" test. |
| Messick and Fritsky (1963) | Group EFT | (Same as above) | Performance on the EFT and the Stroop Test were found to load on the same factor in a factor analytic study. |
| Bloomberg (1969) | Group EFT | (Same as above) | For females, field independence was found to be somewhat related to performance on this test. No relationship was found for males. |
| Hochman (1971) | HFT | (Same as above) | Field independent Ss were found to be superior on this test. |

*Basically, the Stroop Test (Stroop, 1935) requires the individual to name as quickly as possible the color in which each word is printed. However, these words are the names of colors (e.g., "RED" printed in blue ink; "BLUE" printed in yellow ink, etc.). Therefore, the individual must ignore the printed word while reporting the color in which it is printed.

NONVISUAL PERCEPTUAL MEASURES

| Investigator(s) | Measure of Field Dependency-Independancy | Behavioral Variable(s) | Results |
|--|---|--|--|
| White (1953) | EFT | Perception of specific musical notes in a melody. | Ss who had difficulty determining whether the notes were present in the melody also had difficulty on the EFT. |
| Jackson (1955) | EFT | Identification of words presented over a noise background | A significant correlation was found ($r = .46, p < .05$ for men) between EFT performance and the word identification. |
| Axelrod and Cohen (1961) | Gottschaldt Figures Test | Tactile EFT which S performed blindfolded. | A highly significant correlation ($r = .776, p < .01$) was reported between the tactile and visual EFTs. |
| Silverman, Cohen, Shmavonian, and Greenberg (1961) | RFT | Two-point tactile discrimination; identification of letters traced on forehead and hands | Field independent Ss were more sensitive in the two-point discrimination task and more accurate in the letter identification task. |
| Cohen, Silverman, and Shmavonian (1962) | RFT | (Same as above) | Basically, a replication of the above study. Field dependent Ss were poorer on both tasks. |
| Culver, Cohen, Silverman, and Shmavonian (1963) | RFT and Gottschaldt Figures Test | (Same as above) | (Same as above) |
| Sweeney and Fine (1965) | EFT | Rated intensity of pain experienced during immersion of hand in very cold water | High pain reactivity was reported to correspond to field independence; low pain reactivity to field dependence. |
| Silverman, Cohen, and Shmavonian (1967) | RFT | Two-point tactile discrimination; identification of letters traced on forehead and hands. | Field independent Ss were more sensitive in the two-point discrimination task and more accurate in the letter identification task. |
| DuPreez (1967) | RFT | Accuracy of time judgments | Accuracy in time perception did not correlate significantly with RFT scores. |
| DeFazio and Moroney (1969) | EFT | Auditory signal detection task involving a pure tone presented over a white noise background | No relationship was found between the performance on the detection task and EFT scores. |
| Wolf (1971) | Wolf's EFT | 40 item revision of the Guilford-Zimmerman Spatial Perceptual Test | Both the EFT and the spatial test were found to load on the same factor. |
| Walker (1972) | RFT | Tactile RFT | No significant correlation was found between the visual and the tactile forms of the RFT. |

EYE MOVEMENTS AND VISUAL FUNCTIONING

| Investigator(s) | Measure of Field Dependency-Independancy | Behavioral Variable(s) | Results |
|--|--|---|---|
| Gardner and Long (1962) | EFT | Extent of scanning during EFT | The amount of scanning was not found to be related to overall EFT performance, although consistent individual differences in scanning behavior were noted. |
| Burdick (1968) | EFT | Number of eye movements during the EFT | A nonsignificant correlation of .04 was reported between the EFT scores and the number of eye movements per minute. |
| Conklin, Muir, and Boerama (1968) | HFT | Nature of eye movements while viewing various visual stimuli presented on slides | No significant differences were found between field dependent and field independent S_s on the visual stimuli with regard to mean duration of fixation. There was some evidence that field independent S_s had longer mean track length. Field independent S_s were also found to spend more search time in looking at areas of high information content. |
| Barrett, Cabe, and Thornton (1968) | EFT | Individual measures of stereopsis (depth perception) and phoria (eye positioning) | No relationship was found between EFT performance and either measure of visual functioning. |
| Boerama, Muir, Wilton, and Barham (1969) | Group EFT | Number of eye movements and length of fixations during performance of HFT | Field independent S_s made more shifts between target and alternatives on the HFT than did field dependent S_s . |
| Hustmeyer (1970) | Block Design subtest of WAIS (acceptable measure of field dependency; Witkin, 1967). | Number of eye movements during performance on a number of WAIS subtests by diagnosed schizophrenics | A significant correlation ($r = .45, p < .05$) was found between eye movements and scores on the Block Design Test. However, this may have been due to an underlying factor of intelligence which also correlated with both measures. |

MEMORY

| Investigator(s) | Measure of Field Dependency-Independence | Behavioral Variable(s) | Results |
|---|---|---|---|
| Witkin, Dyk, Faterson, Good- enough, and Karp (1962) | EFT and RFT | Incidental memory for the words in Stroop Color-Word Test and for TAT cards | Field independent Ss were superior in their memory for the color words and the TAT cards. |
| Measick and Damarin (1964) | EFT | Incidental recall of photographed human faces | Field dependent Ss recalled more faces correctly than did field independent Ss. |
| Uhlman and Saltz (1965) | EFT | Immediate and delayed recall of connected discourse | Field independent Ss were superior in both immediate and delayed (3 hr.) recall. |
| Fitzgibbons, Goldberger, and Eagle (1965) | Group EFT | Recall and recognition of socially oriented and neutral words presented incidentally during Digit Symbol sub- test from the WAIS | A highly significant correlation ($r = -.61, p < .001$) was reported between EFT performance and the recall for socially oriented words. A similarly high correlation ($r = -.44, p < .01$) was reported for EFT performance and the recognition of socially oriented words. There was no signi- ficant relationship between the EFT and either recall or recognition of the neutral words. |
| Eagle, Fitzgibbons, and Goldberger (1966) | EFT | Recall and recognition of socially oriented and neutral words presented incidentally during a Digit Symbol subtest from the WAIS. Memory for the symbols was also tested. | There was a significant relationship between both recall and recognition of the symbols and EFT performance ($r = .60, p < .01$; $r = .44, p < .01$, respectively), field indepen- dent Ss being superior. Contrary to hypothesis, no relation was noted between the EFT and memory for the incidental material. |
| Fitzgibbons and Goldberger (1971) | Group EFT and RFT | Recall and recognition of socially oriented and neutral words presented incidentally during a Digit Symbol subtest from the WAIS | Basically, a replication of above study. The more field dependent the S (on either the EFT or RFT), the more social words recalled and recognized. |
| Gorman (1968) | HFT | Paper-and-pencil maze task | Field independent Ss performed significantly better than field dependent Ss on this task. |
| Wachtel (1971) | RFT | Ss were required to learn the nonsense syllable "names" arbi- trarily assigned to a series of complex designs | RFT performance was unrelated to learning the names of the overall designs, but good RFT performance was associated with better ability to identify part aspects of the designs. |

PROBLEM SOLVING

| Investigator(s) | Measure of Field Dependency-Independence | Behavioral Variable(s) | Results |
|--|---|---|--|
| Guetzkow (1951) | Gottschaldt Figures Test and HFT | Performance on the Einstellung Test (Luchins, 1951) requiring S to break his "set" to solve a problem | "Set-breakers," who correctly solved the problem, were significantly better both on the HFT and the Gottschaldt Test than the "non set-breakers." |
| Jeffreys (1953) | Gottschaldt Figures Test | Einstellung Test | No significant relation between the method of problem solving and the Gottschaldt Figures Test was found. |
| Zaks (1954) | Gottschaldt Figures Test | Einstellung Test | Subjects who were most influenced by set (had a more difficult time solving the problem) scored significantly poorer on the Gottschaldt Test. |
| Fenchel (1958) | EFT | Einstellung Test | A significant relation was found ($r = .36, p < .01$) between speed in solving the problem and EFT performance. |
| Goodman (1960) | Gottschaldt Figures Test, EFT, and RFT | Einstellung Test | Significant correlations were found between problem solution time and both EFT and Gottschaldt Test performance. No relation was found for the RFT. |
| Harris (cited in Witkin et al., 1962) | EFT | Dunker (1945) insight problems | Significantly more field independent Ss solved both insight problems than did field dependent Ss. |
| Witkin, Dyk, Fatterson, Good- enough, and Karp (1962) | EFT and RFT | Twelve of Guilford's insight problems (1957) | Significant correlations between problem solving ability and both the EFT ($r = .58, p < .01$) and the RFT ($r = .40,$ $p < .05$) were reported. |
| Bloomberg (1965) | EFT | Performance on a series of anagrams, each of which consisted of scrambled letters which could form only one word | Field dependent Ss were found to make a greater number of incorrect solutions than field independent Ss. |

PSYCHOMOTOR PERFORMANCE

| Investigator(s) | Measure of Field Dependency-Independence | Behavioral Variable(s) | Results |
|---|---|--|---|
| Wilkins, Lewis, Hertzman, Machover, Meisner, and Wapner (1954) | RFT | Two-hand coordination test (McFarland-Channell, 1944) | For both males and females, field independent <u>Ss</u> were superior on this coordination task. |
| Podell and Phillips (1959) | EFT | (Same as above) | (Same as above) |
| Benfari and Vitale (1965) | RFT | In an aircraft simulator <u>S</u> tracked an aircraft to a carrier landing. | Field independent <u>Ss</u> were superior to field dependent <u>Ss</u> under conditions of both visual feedback alone and full visual and proprioceptive feedback. |
| Barrett and Thornton (1968) | RFT | Emergency reaction in a driving situation | Field independent <u>Ss</u> were superior on all three of the criterion measures employed: reaction time, deceleration rate, hit-miss. |
| Cullen, Harper, and Kidera (1969) | RFT | Pilot occupation. | Pilots were found to be significantly more field independent than aerospace engineers, a group which has been reported to be more field independent than the general population. |
| Harano (1970) | EFT | Motor-vehicle accident involvement (frequency) | Field dependent individuals were found to have been in significantly more accidents than field independent persons. |
| Dargel and Kirk (1971) | HFT | Multiple reaction time tests of varying difficulty levels | Field independent <u>Ss</u> were superior to field dependent <u>Ss</u> only on tasks of moderate difficulty. For easy or difficult task, no differences were noted. |

BODY STEADINESS AND BALANCE

| Investigator(s) | Measure of Field Dependency-Independancy | Behavioral Variable(s) | Results |
|------------------------------------|---|---|---|
| Witkin and Wapner (1959) | RFT | Performance on an staximeter which registers a cumulative record of forward-backward and left-right movements of the body (i.e., body steadiness) | In general, no relationship was found between the RFT scores and measures of body steadiness under either stable or unstable conditions of the visual surroundings. |
| Wapner and Witkin (1950) | RFT | Performance on a stabiometer which gives an index of S's bodily balance | As in the above study, under both stable and unstable visual conditions no significant relationships were found between bodily balance and the RFT for either men or women. |
| Shugart, Souder, and Bunker (1972) | RFT | Performance on a "dynamic, non-locomotor balance test" (stabilometer) | Among high-school age females, those who had better scores on the RFT (more field independent) also scored significantly better on this balance test. |

APPENDIX B

PROPOSED INVESTIGATIONS TO BE CONDUCTED AT NAMRL WITH THE EFT AND RFT

1. By the rather simple administering of both the EFT and RFT to incoming students in the flight program, three important results could be forthcoming:

(a) a replication of Kennedy's work with the EFT concerning an increase in prediction of success in the aviation training program.

(b) standardization of the EFT and RFT on the rather select population of student aviators and naval flight officers.

(c) determination of the equivalence of the EFT and RFT for our population.

2. The proposal in the present paper concerning the physiological basis of the FD-FI differences is currently being investigated directly with physiological measures such as GSR and heart rate.

3. The relationship between eye movements or scanning behavior and perceptual style might be of interest concerning performance on the Multiboath-Automated-Research-Test-System (MARTS). As mentioned in the paper, there has been some successful work in this area.

4. Also on the MARTS, it would be of interest to investigate any time-sharing differences between FD and FI Ss (i.e., stress effects).

5. It would also be possible to test the hypothesis proposed by Cullen and his co-workers (1969) that good flight instructors as a group would not be so extremely FI as other pilots. They suggest that some of the FD personality characteristics are needed for good instructors.

6. The investigation of the differential abilities of FD and FI Ss on such tasks as radar operating and the GRAM system operating which require an apparent ability to detect a signal "hidden" or embedded in a background of extraneous signals could be of very practical value.

7. Minkowich (1965, 1967) reported that FI Ss demonstrated greater "Risk-Taking" behavior than FD Ss. Current work at NAMRL is involved with risk-taking and aviation personnel. Some initial attempts have been made to evaluate possible field dependency-independency correlates with such behavior.